Impeller
Data Industrial®

Transmitters

Series 340 BN/MB Btu Energy Transmitter

XMT-UM-01660-EN-04 (August 2015)

User Manual

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INTRODUCTION

The Data Industrial 340 BN/MB Btu Energy Transmitter from Badger Meter® is an economical, compact device for hydronic sub-metering applications. It uses an RS-485 connection for Modbus® and BACnet communication protocols and a solid-state switch for pulse output representing either flow or energy.

The 340 BN/MB Btu Energy Transmitter calculates thermal energy by integrating the liquid flow in a closed pipe system and the differential temperature between the supply and return. The transmitter requires one flow sensor and two temperature sensors.

The temperature sensors can be two-wire 10k Ω Type II Thermistors or 100 or 1000 Ω RTDs that follow the IEC 751 curve.

The flow input may be provided by many of the Data Industrial line of flow sensors and other manufacturers' devices that generate pulse or sine waves.

The onboard microprocessor and digital circuitry make precise measurements and produce accurate drift-free output. The transmitter is programmed using the Badger Meter Windows® software and a Data Industrial Series A301 programming cable. Calibration information for the flow sensor, units of measurement, communication protocol settings and output scaling may be downloaded prior to installation or in the field.

The RS-485 Modbus settings include Baud Rate, Address and RTU/ASCII.

The RS-485 BACnet is an MS/TP slave device and includes Address, Baud Rate, Device Name, Device Instance Number and Max Master Valve.

While the unit is connected to a PC or laptop computer, real-time flow rate, flow total, both temperature readings, energy rate and energy total are available.

Features

- Three LEDs to indicate flow sensor activity, RS-485 activity and pulse output.
- Isolated solid-state switch closure is user programmed for units of energy or flow. The output pulse width is adjustable from 10 ms to 5 sec.
- Operates on AC or DC power supplies ranging from 12…24V AC or 12…35V DC.
- Compact cast epoxy body measures 3.65 × 2.95 inches (93 × 75 mm) and can be easily mounted on panels, DIN rails or enclosures.

INSTALLATION

Mechanical Installation

The transmitter may be surface mounted onto a panel, attached to DIN rails using adapter clips or wall mounted using two optional enclosures.

Location

Although the transmitter is encapsulated, all wiring connections are made to exposed terminals. The unit should be protected from weather and moisture in accordance with electrical codes and standard trade practices.

In any mounting arrangement, the primary concerns are ease of wiring and attachment of the programming cable.

The unit generates very little heat so no consideration needs to be given to cooling or ventilation.

Surface Mount Installation

The transmitter may be mounted to the surface of any panel using double-sided adhesive tape or by attaching fasteners through the holes in the mounting flanges of the unit.

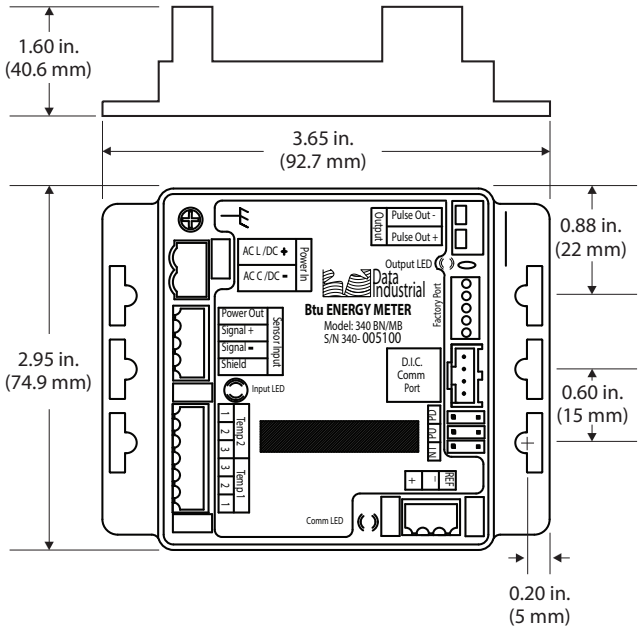

Figure 1: 340 BN/MB dimensions

Wall Mounting

Optional metal and plastic enclosures are available to mount the transmitter to a wall when no other enclosure is used. The enclosure is first attached to the wall using fasteners through its mounting holes.

After wiring, the transmitter may be attached to the enclosure with the terminal headers facing in, using the slots in the mounting flanges. As an alternate mounting arrangement, the transmitter may be fastened to the box cover using double-sided adhesive tape.

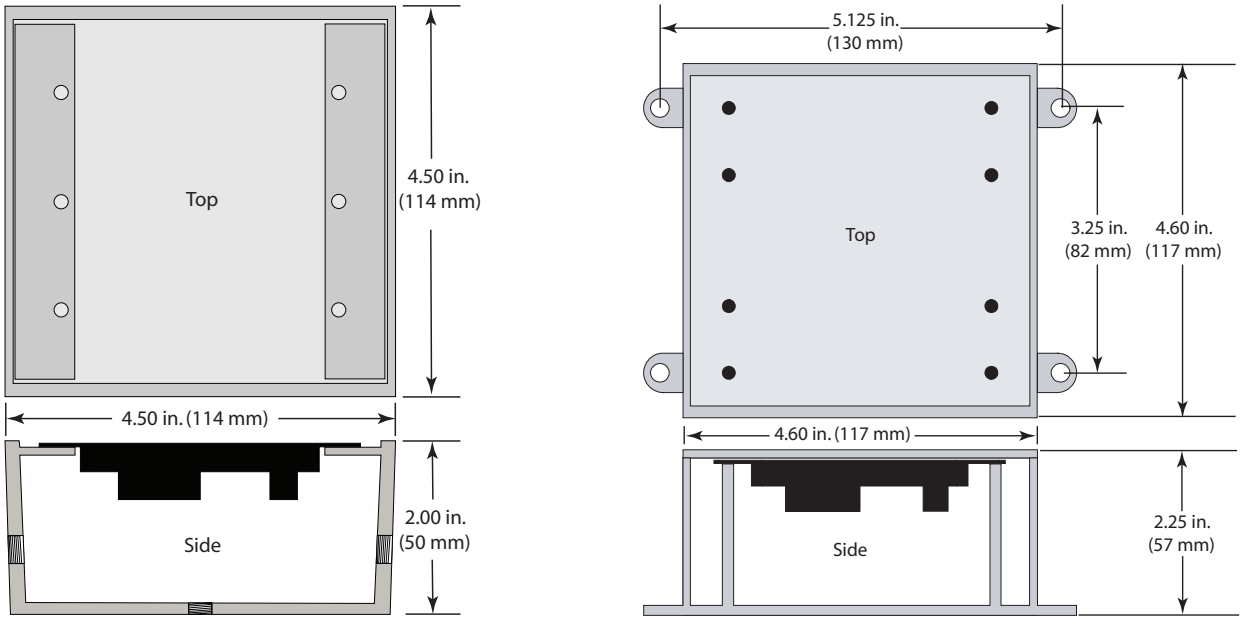

Figure 2: 340 BN/MB metal (left) and plastic (right) box dimensions

DIN Rail Mounting

Optional clips snap onto the mounting flanges allowing the transmitter to be attached to DIN 15, 32, 35 mm DIN rail systems.

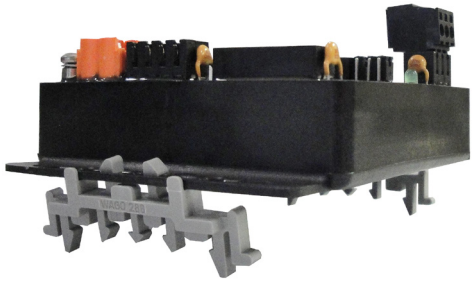

Figure 3: DIN rail mounting

Temperature Sensor Installation

Badger Meter offers several styles of 10k Ω Thermistors and 100 Ω Platinum RTDs in both direct immersion and Thermowells. The style selected depends on system requirements and pipe size.

Direct Insert

Generally, direct insert sensors are used for smaller pipe sizes.

Figure 4: Direct insert

Thermowell

Thermowells are recommended for larger pipes that are more difficult to drain for service.

Figure 5: Thermowell

Hot Tap

For pipes that cannot be drained even for initial installation, a Hot Tap version is available. Model THT is available in the 10k Ω Thermistor version only.

Figure 6: Hot tap

Electrical Installation

All connections to the transmitter are made to screw terminals on removable headers.

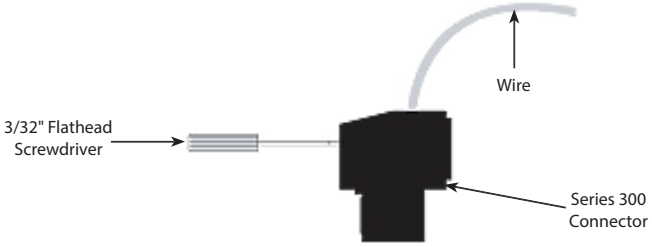

Figure 7: Side View - Typical series 300 removable connector wiring

Power Supply Wiring

The transmitter requires 12…24V AC/DC to operate. The power connections are made to the ORANGE header. The connections are labeled beside the header. Observe the polarity shown on the label.

If a Badger Meter plug-in type power supply (Series A-1026 or A-503) is used, connect the black/white striped wire to the terminal marked positive (+) and the black wire to the terminal marked negative (–).

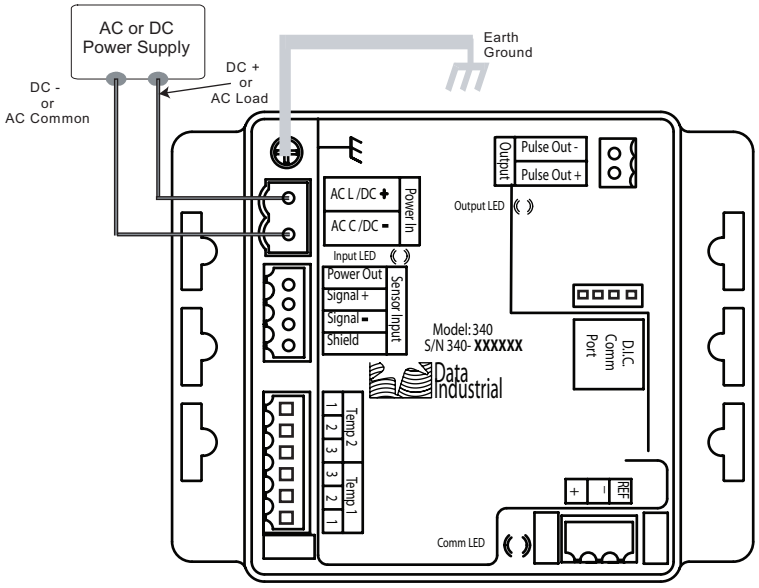

Figure 8: Sample power supply wiring

NOTE: Included with every transmitter is a 340IK kit containing a screw, lock washer and nut to connect the transmitter to earth ground. Connect the earth ground lug of the transmitter to a solid earth ground with as short a wire as possible. This will help prevent electrical interference from affecting the transmitter's normal operation.

Sensor Wiring

All flow sensor types connect to the four terminal headers labeled *Sensor Input*.

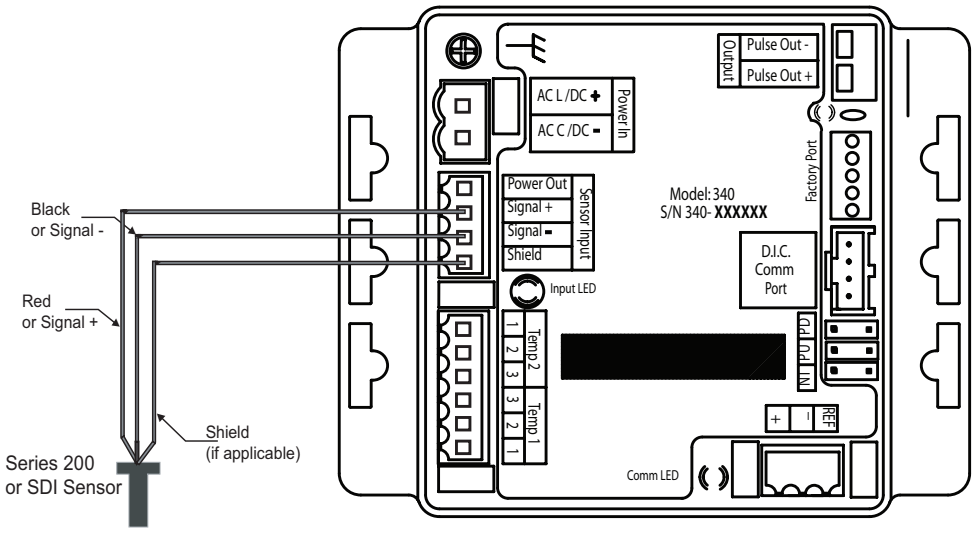

Figure 9: Sample sensor wiring diagram

Series 200

Connect the red wire to sensor signal (+), black wire to sensor signal (–) and the bare wire to shield.

SDI Series

Connect the plus (+) terminal of the sensor to sensor signal (+) on the transmitter and the minus (–) terminal of the sensor to sensor signal (–) on the transmitter. Connect the shield terminal of the sensor to the shield terminal of the transmitter.

Other Flow Sensors

The sensor input power out terminal supplies nominal 12V DC excitation voltage for three-wire sensors. Connect sensor signal (+) and sensor signal (–) wires to transmitter terminals.

The transmitter is very versatile and can accept both pulse and zero crossing sine wave flow sensors. Excitation voltage is also provided for three-wire powered sensors.

See *"Programming" on page 14* for configuration instructions.

Temperature Element Wiring

Appropriate wire types and proper shielding is required for accurate temperature readings.

Since Btu calculations are based on Delta T cable, in order to maintain a balanced system, T1 and T2 wire runs should be kept to approximately the same length, not to exceed 500 feet.

Thermistors

Badger Meter thermistors are not polarity-sensitive, therefore, wire color is unimportant. Connect the thermistor located in the same pipe as the flow sensor—temperature sensor T1—to terminals 2 and 3 on terminal block Temp 1. Connect the thermistor located in the other pipe—temperature sensor T2—to terminals 2 and 3 on terminal block Temp 2. Install a jumper between terminals 1 and 3 for both the T1 and T2 input terminals. Terminals 1 and 3 are used for lead resistance compensation when 100 three-wire RTDs are used and must be jumpered when not used.

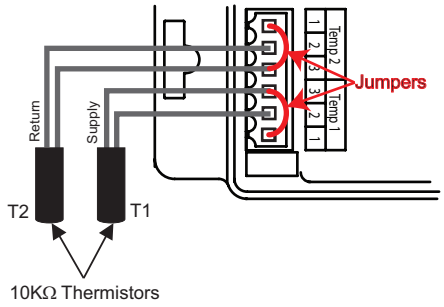

Figure 10: Thermistor wiring diagram

Resistance Temperature Detectors (RTDs)

Badger Meter RTDs are three-wire devices. Two of the wires are the same color and interchangeable. One wire is current-carrying and connects to terminal 3. The other is used for lead compensation and connects to terminal 1. The single color lead is attached to terminal 2. Connect the RTD located in the same pipe as the flow sensor—temperature sensor T1—to terminal block Temp 1. Connect the RTD located in the other pipe line—temperature sensor T2—to terminal block Temp 2.

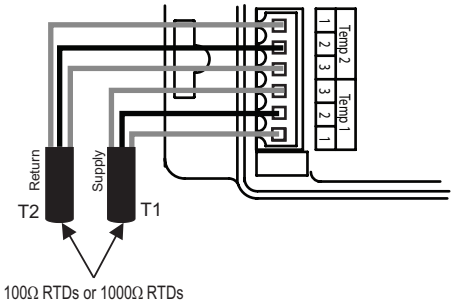

Figure 11: RTD wiring diagram

Pulse Output Wiring

The transmitter has solid-state switch output rated for a maximum sinking current of 100 mA at 36V DC. In most cases the pulse out (+) terminal of the transmitter will connect to the input pulse (+) and the pulse out (–) terminal to the input pulse (–) of the receiving device. Although labeled +/–, the pulse output is not actually polarity sensitive and can switch low level AC loads if required.

These terminals are located on a separate two-terminal removable header on the transmitter, labeled *Output*.

Connecting the RS-485 Bus

The position of jumpers on each transmitter (see *Figure 12*) and wiring between each transmitter and the RS-485 network are different depending on the transmitter's nodal position. For all but the final transmitter in a string, put the three jumpers (NT, PU and PD) in the open position, and connect only the (+) and (–) network terminals to the RS-485 bus.

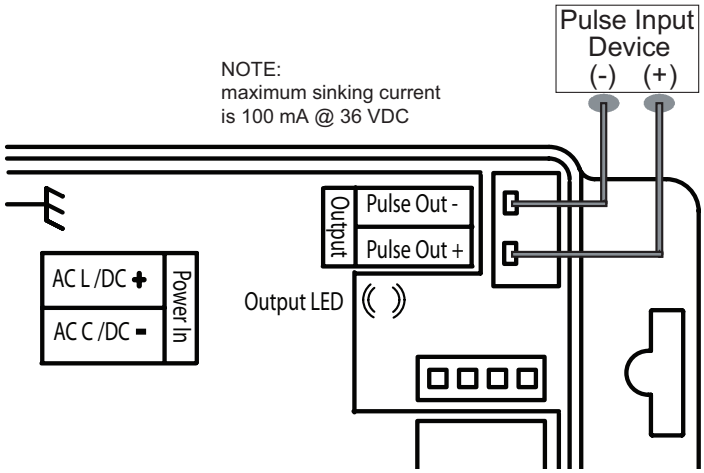

Figure 12: Sample pulse output wiring diagram

For the final transmitter in a Modbus network, the three jumpers NT, PU and PD should be in the closed position, and all three network terminals, (+), (–) and REF, should be connected to the Modbus bus.

NOTE: The transmitter default Modbus or BACnet polling address must be changed before it is introduced into an existing network to avoid possible address conflicts.

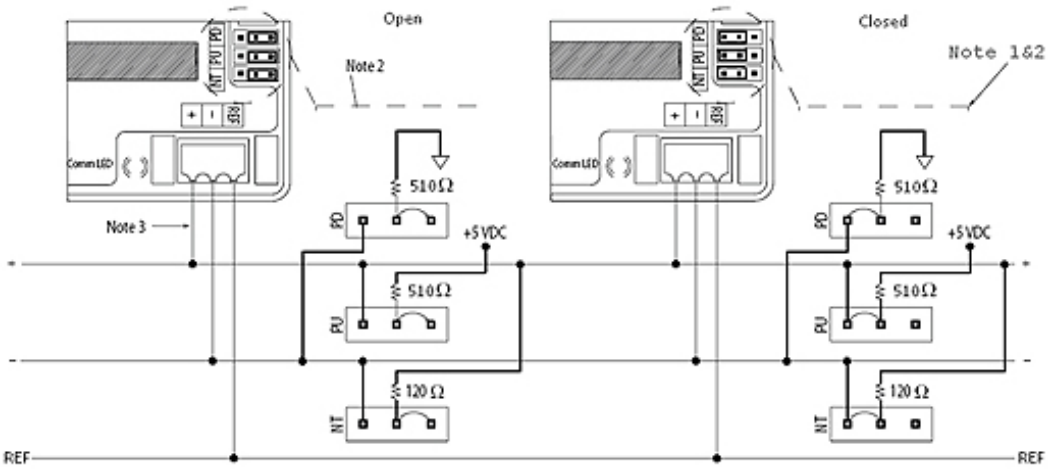

Figure 13: Sample wiring diagram to modbus network

- Biasing, circuitry and resistors for PU, PD and NT terminals are integral parts of the transmitter.
- For the final transmitter in a given RS-485 network string, NT, PU and PD jumpers should be in the closed position. Otherwise, NT, PU and PD should be in the open position.
- For the final transmitter in an RS-485 string, all three network terminals, (+), (-) and REF, should be connected to the bus. Otherwise, connect only terminals (+) and (-) to the bus.

Do not connect to the RS-485 network until the transmitter has been configured per the instructions in *"Programming" on page 14*.

See *"RS-485 Network Configurations" on page 20*.

Communications Cable Wiring

Field configuration requires a Data Industrial programming kit (consisting of a custom cable and software) and a PC running Windows 9x, ME, NT, 2000 or Windows 7. In order to connect, the transmitter must be powered, and the Data Industrial Series A301 cable must be connected to the transmitter COM port connector and an available 9-pin COM port on a computer. USB-to-COM Port adapters can be used if the DB9 COM port is not available.

NOTE: The Data Industrial A301 Cable will work with all Series 300 products. However the older version of the cable (A300) does not have sufficient bandwidth to work with the 340 BN/MB Btu Transmitters.

Badger Meter provides free programming software updates at *www.badgermeter.com* for all Series 300 products.

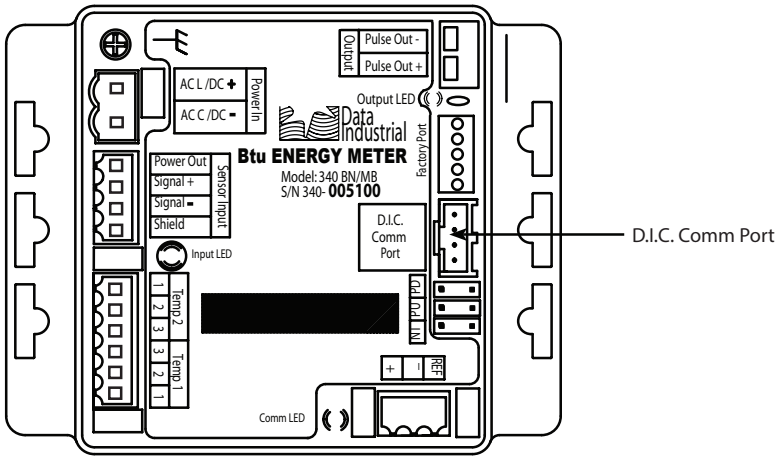

Figure 14: Location of the DIC COMM port

PROGRAMMING

Connecting Via DIC COM Port

To program the transmitter, follow these steps:

1. Load the interface software into the computer.
2. Power the transmitter with 12…24V AC/DC.
3. Connect the computer to the transmitter with the Data Industrial Series A-301 communications cable to the socket labeled "D.I.C. COM port", taking care to properly align the tab on the plug and socket to maintain polarity. Connect the DB9 connector of the Data Industrial Series A301 communications cable to a PC COM port that has the 340 software installed. If a DB9 COM port is not available, a USB to COM Port Adapter may be purchased locally.
4. Open the program and from the *Device* tab and select **340** as shown in *Figure 15*.

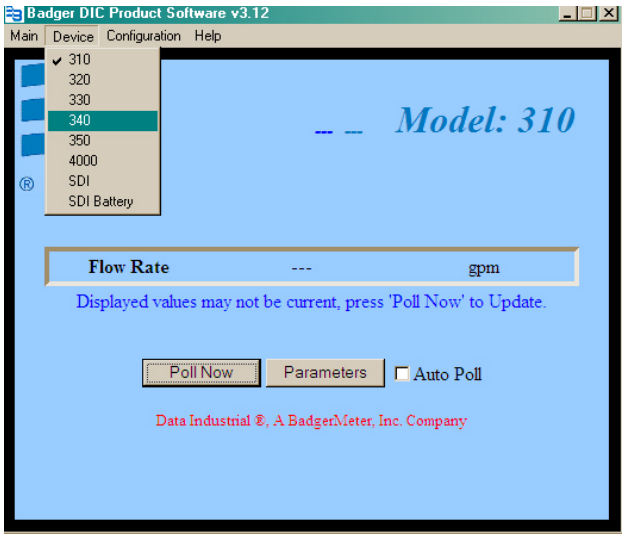

Figure 15: Select 340

5. Select the Device Type, **340BN/MB**.

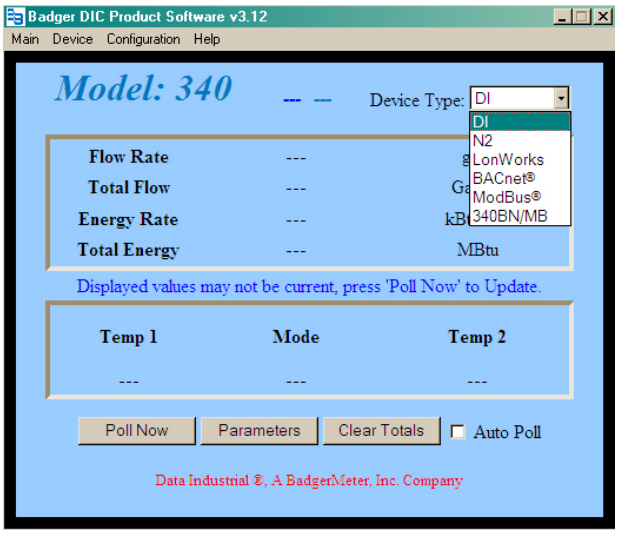

Figure 16: Device type

6. Under the *Configuration* tab, select **Set Comm Port**.

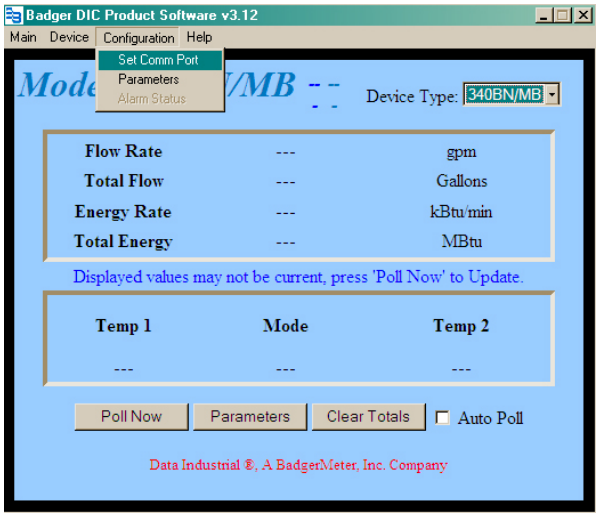

Figure 17: Select SET COM PORT

7. Select the Comm Port from the drop-down menu.

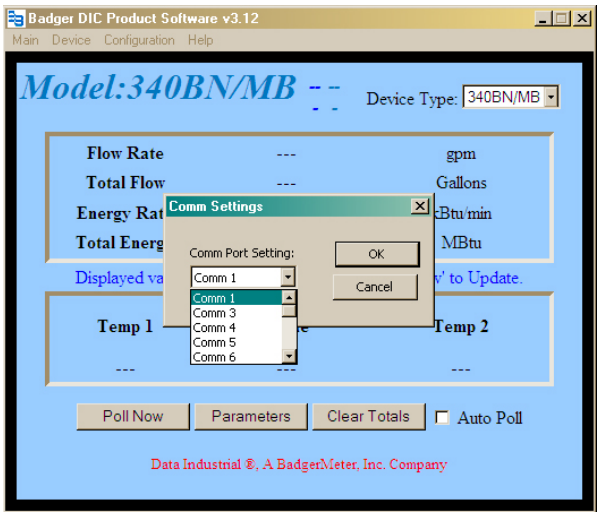

Figure 18: Select the COM PORT

If the COM and Device type have been properly selected, the "---" will be replaced with values.

NOTE: If this does not occur, communication has not been established and you cannot continue to the next step. If it does not connect automatically, click on **Poll Now**.

a. If communication still does not occur and you are using a DB9-to-COM 1 or COM2, try using a USB-to-COM adapter. This usually creates a new COM port that was not previously listed. Use the Windows Device Manager to determine the actual COM ports that are available.

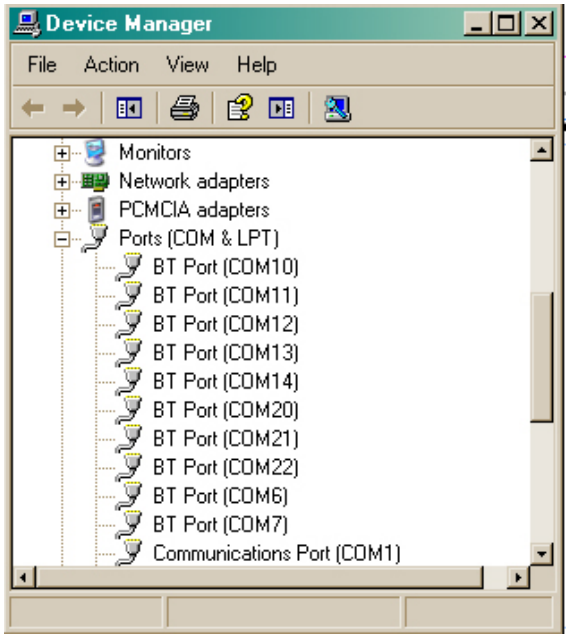

Figure 19: Device manager

b. Select this new port created by the adapter and the screen should change as shown in *Figure 20*. The dashes ("---") are replaced with values, confirming normal communications.

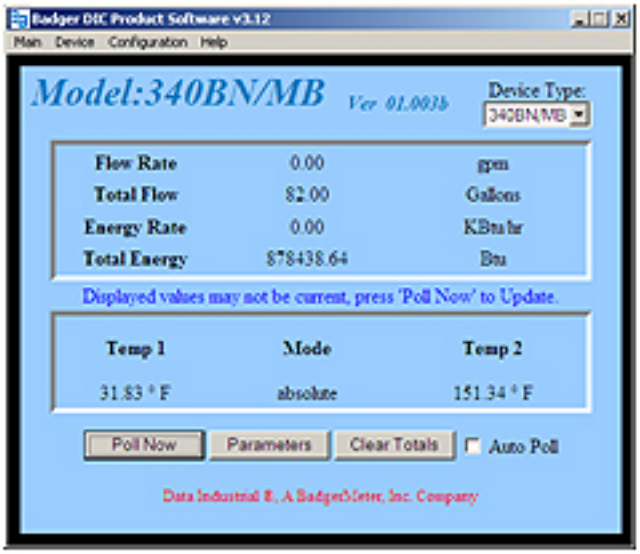

Figure 20: Screen change

8. When communication has been confirmed, click **Parameters**. The *Parameters* screen is displayed.

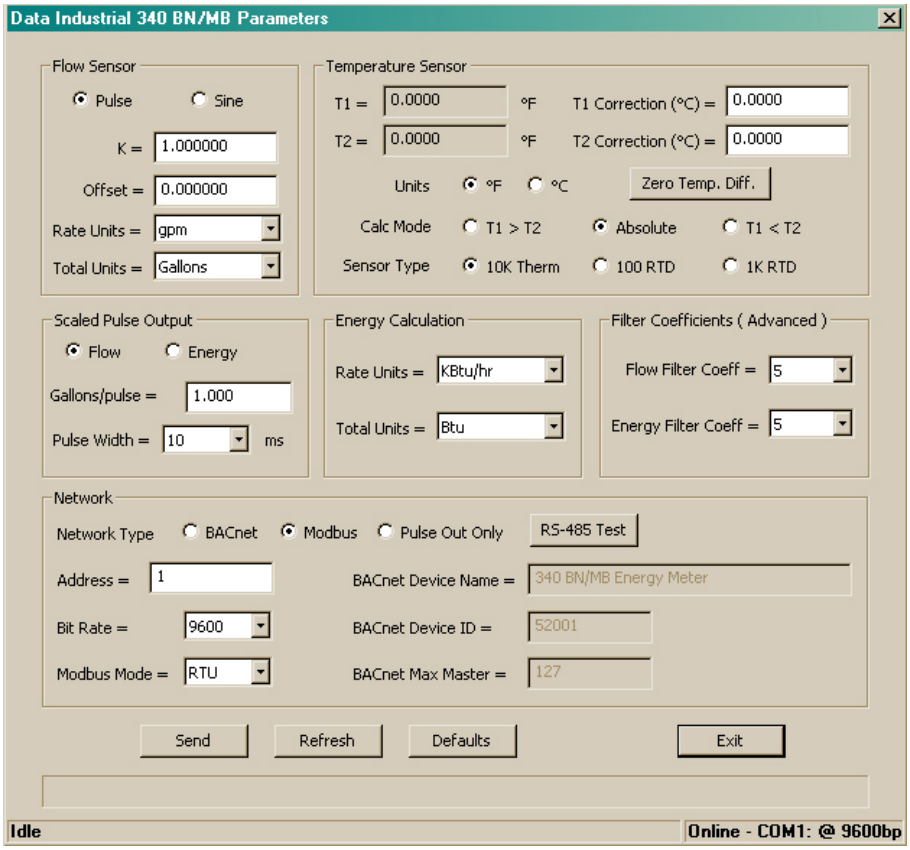

Figure 21: Parameters screen

9. From this screen, set up the following:
   - ◊ Flow Sensor Type, Scaling and Units
   - ◊ Temperature Sensor Type, Units, Mode and Zeroing
   - ◊ Energy Calculation Units of Measure
   - ◊ Filter Coefficients (Flow and Energy averaging for reading stability)
   - ◊ Scaled Pulse Output Resolution and Pulse Width
   - ◊ RS-485 Network Configuration (BACnet or Modbus)
10. Press **Send** before leaving this page to save any changes.

    Refresh rereads the unit and refreshes the screen. **Defaults** restores all factory settings. **Exit** returns to the main screen.

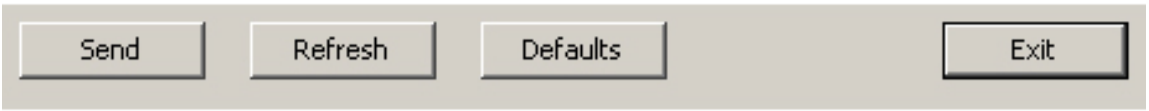

Figure 22: Parameter screen buttons

Flow Sensor Section

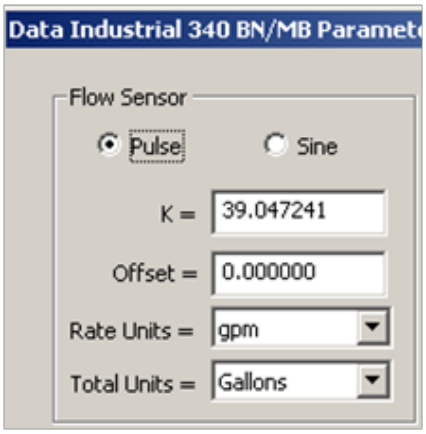

Figure 23: Pulse or sine

For most Data Industrial sensors, the sensor type is *Pulse*, and the *K* and *Offset* values can be found in the respective flow sensor user manual.

Sine is used for zero-crossing flow sensors (some turbine meters, for instance).

Several flow rate and flow total units of measure can be selected from the pull-down menu.

Temperature Sensor Section

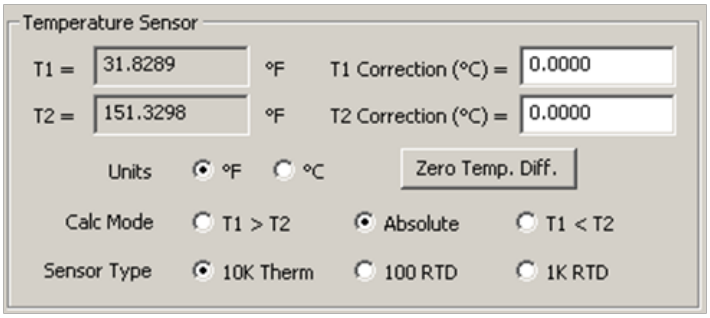

Figure 24: Sensor attributes

Choose the **Sensor Type** (10K Ω Thermistor, 100 Ω RTD, or 1K RTD).

Calc Mode

The **Calc**(ulation) **Mode** has three selections.

- In *Absolute* mode, the Energy Rate and Total are calculated as positive values, regardless of the direction of energy flow.
- In *T1>T2* mode, energy is only calculated if the T1 sensor is warmer than the T2 sensor. If T1 is cooler than T2, the energy rate remains at 0.0 and the energy total does not increase.
- In the *T1<T2* mode, energy is only calculated if the T1 sensor is cooler than the T2 sensor.

The *T1=* and *T2=* are simply for reference to indicate the current temperature readings, which is useful when using the zeroing feature.

The *Zero Temp Diff* is a very powerful feature in this product that cancels out any inaccuracies of drift in the temperature sensors or the transmitter temperature measurements.

If the temperature sensors are known to be at exactly the same temperature, click **Zero Temp Diff** to automatically zero the difference between the two readings. To correct for any erroneous entries, simply manually type 0.0 in both fields.

IMPORTANT

If used incorrectly, the temperature readings will be incorrect and the energy rates and totals will also be in error.

Energy Calculation

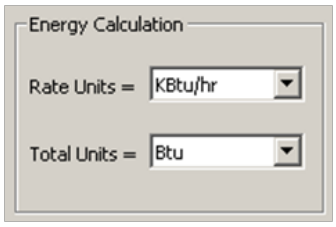

Figure 25: Rate and total units

Select the units of measure for energy rate and total from the pull-down menus.

Filter Coefficients

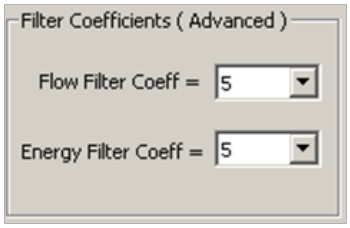

Figure 26: Filter coefficients

For most applications, leave the default setting of 5. If the flow rate or energy rates are unstable for some reason (from a disturbed flow profile, for example), this value can be increased as needed.

Scaled Pulse Output

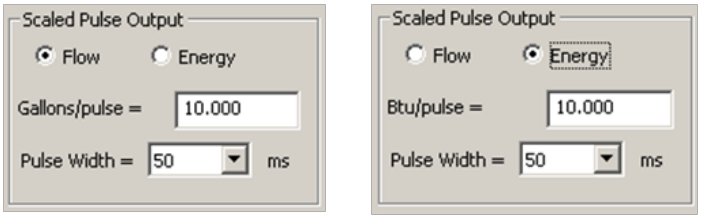

Figure 27: Flow or energy

The scaled pulse output can represent either **Flow** or **Energy**. Units are the same as selected in the previous sections.

Pulse width and pulse resolution will be selected based on the requirements of the receiving device and system requirements.

RS-485 Network Configurations

The *RS-485* section can be configured in three ways:

- Pulse Out Only (RS-485-OFF)
- Modbus
- BACnet

RS-485 Network Configuration, Pulse Out Only

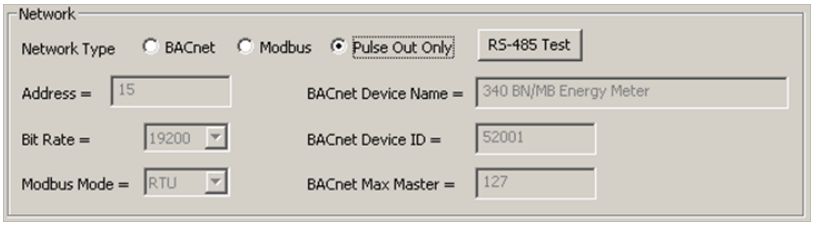

Figure 28: Pulse out only option

If the Modbus or BACnet communications are being used, select the **Pulse Out Only** setting to disable the RS-485 Network.

RS-485 Network Configuration, Modbus

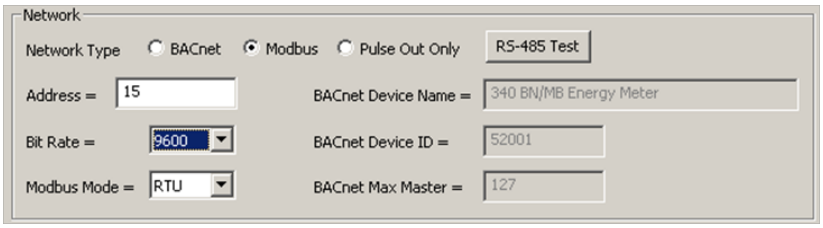

Figure 29: Modbus option

Select **Modbus** to access the Modbus pull down menus.

Select the **Address**, **Bit Rate** (Baud Rate) and **Mode** (RTU or ASCII).

The transmitter uses IEEE 754 Float - Data Located in "Holding Registers."

The 340BN/MB Data Format is "Float 32" where the Data is stored across two "Holding Registers".

In the case of Temperature 1, the Upper Byte is stored in Register 40002, and the Lower Byte is stored in Register 40001, sometimes referred to as an ABCD to CDAB format. This is done to permit backwards compatibility with older 16-bit systems.

For example, a temperature of 53.36° F when converted to IEEE 754 is 425570A4. So in the case of the 340BN/MB, Register # 40001 = 70A4 Hex and Register # 40002 = 4255 Hex. See *Table 1 on page 21* for additional information.

Modbus Register Map

Model 340BN/MB Register Map			
Register Name	Address	Data Type	Read/Write
Temperature 1	40001 + 40002	IEEE 754 Float	Read Only
Temperature 2	40003 + 40004	IEEE 754 Float	Read Only
Flow Input (Hz)	40005 + 40006	IEEE 754 Float	Read Only
Total Flow	40007 + 40008	IEEE 754 Float	Read Only
Total Energy	40009 + 40010	IEEE 754 Float	Read Only
Flow Rate	40011 + 40012	IEEE 754 Float	Read Only
Energy Rate	40013 + 40014	IEEE 754 Float	Read Only
K Factor	40015 + 40016	IEEE 754 Float	Read Only
Offset	40017 + 40018	IEEE 754 Float	Read Only
Temp Calc Mode	40019 + 40020	IEEE 754 Float	Read Only
Flow Filter Coef	40021 + 40022	IEEE 754 Float	Read Only
Temp Filter Coef	40023 + 40024	IEEE 754 Float	Read Only
Specific Heat	40025 + 40026	IEEE 754 Float	Read Only
Fluid Density	40027 + 40028	IEEE 754 Float	Read Only
T1 A Coefficient	40029 + 40030	IEEE 754 Float	Read Only
T1 B Coefficient	40031 + 40032	IEEE 754 Float	Read Only
T1 C Coefficient	40033 + 40034	IEEE 754 Float	Read Only
Temp 1 Offset	40035 + 40036	IEEE 754 Float	Read Only
T1 A Coefficient	40037 + 40038	IEEE 754 Float	Read Only
T1 B Coefficient	40039+ 40040	IEEE 754 Float	Read Only
T1 C Coefficient	40041 + 40042	IEEE 754 Float	Read Only
Temp 1 Offset	40043 + 40044	IEEE 754 Float	Read Only

Table 1: Modbus register map

RS-485 Network Configuration, BACnet

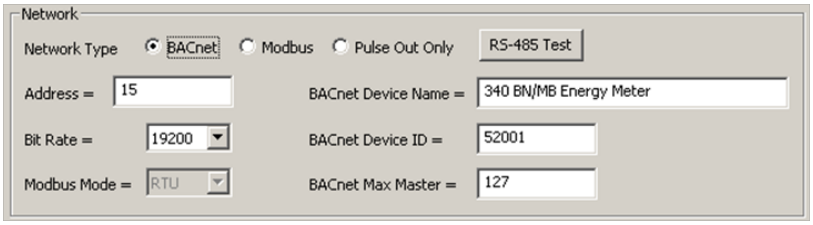

Figure 30: BACnet option

Select **BACnet** to access the BACnet pull down menus.

Select the **Bit Rate** (BAUD rate) to match other devices on the network.

BACnet Device Name can be set to help identify this device and location.

BACnet Device ID (Incidence #) is a unique number that identifies this device on the network. Typically, the first part of the number is the same as the network #, and the last two characters are the same as the **Address**.

NOTE: This is not a requirement, but can help in system planning.

BACnet Object Map

Description	ID	Name	Out of Service	Units
Analog Input	AN1	TempIn	FALSE	° C, ° F
Analog Input	AN2	TempOut	FALSE	° C, ° F
Analog Input	AN3	FreqIn	FALSE	Hz
Analog Input	AN4	VolFlow	FALSE	gpm, gph, lpm, lph, ft^3/s, ft^3/m, ft^3/h, m^3/s, m^3/min, m^3/h
Analog Input	AN5	EnrgyFlow	FALSE	kBtu/min, kBtu/h, kW, MW, HP, Tons
Analog Value	AV1	TotalVol	FALSE	gallons, liters, ft^3, m^3
Analog Value	AV2	TotEnergy	FALSE	Btu, kBtu, MBtu, kWh, MWh, kJ, MJ
Analog Value	AV3	Kfactor	FALSE	dimensionless
Analog Value	AV4	Offset	FALSE	dimensionless
Analog Value	AV5	TempMode	FALSE	dimensionless
Analog Value	AV6	FFilterCoef	FALSE	dimensionless
Analog Value	AV7	TFiltCoef	FALSE	dimensionless
Analog Value	AV8	SpHtCapac	FALSE	Btu/lb-F
Analog Value	AV9	Density	FALSE	lb/gallon
Analog Value	AV10	InTACoef	FALSE	dimensionless
Analog Value	AV11	InTBCoef	FALSE	dimensionless
Analog Value	AV12	InTCCoef	FALSE	dimensionless
Analog Value	AV13	InTOffset	FALSE	° C, ° F
Analog Value	AV14	OutTACoef	FALSE	dimensionless
Analog Value	AV15	OuTBCoef	FALSE	dimensionless
Analog Value	AV16	OutTCCoef	FALSE	dimensionless
Analog Value	AV17	OutTOffset	FALSE	° C, ° F

Table 2: BACnet object map

BACnet Protocol Implementation Conformance Statement

Products

Product	Model Number	Protocol Revision	Software Version	Firmware Version
340 BN/MB	B340BN	135-2001		Rev 1.00

Vendor Information

Badger Meter, Inc
6116 E 15th Street
Tulsa, OK 74112
www.badgermeter.com

Product Description

The 340 BN/MB Btu Energy Transmitter is a low cost, flow and temperature sensor interface used in submetering applications. An additional communication design feature provides connectivity for BACnet® MS/TP.

BACnet Standardized Device Profile

Product	Device Profile	Tested
340 BN/MB	BACnet Smart Sensor (B-SS)	

Supported BIBBs

Product	Supported BIBBs	BIBB Name	Tested
340 BN/MB	DS-RP-B	ReadProperty-B	
	DS-WP-B	WriteProperty-B	

Standard Object Types Supported

Product	Object Type	Creatable	Deletable	Tested
340 BN/MB	Analog Input	No	No	
340 BN/MB	Analog Value	No	No	
340 BN/MB	Device	No	No	

Data Link Layer Options

Product	Data Link	Options	Tested
340 BN/MB	MS/TP Slave	Baud rates 9600, 19200, 38400, 75800	

Segmentation Capability

Product	Segmentation Type	Supported	Window Size (MB/TP product limited to1)	Tested
340 BN/MB	Able to fragment segmented messages	No		N/A

Device Address Binding

Product	Static Binding Supported	Tested			
340 BN/MB	No	N/A			

Character Sets

Product	Character Sets Supported	Tested			
340 BN/MB	ANSI X3.4				

Table 3: BACnet conformance statement

RS-485 Network Test

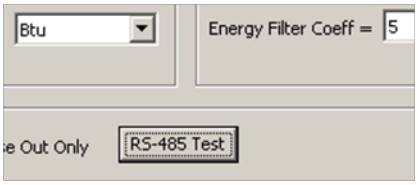

Figure 31: RS-485 test

The Configuration Software has an RS-485 test program.

Although it uses Modbus settings, it is testing RS-485 communication.

The test requires connection to a COM port using the Data Industrial A302-20 RS 485 to RS-232 converter cable. This cable can also be helpful with other diagnostics programs and devices that use an RS-232 port to communicate.

When testing the RS-485 network, it is sometimes helpful to connect to some other location instead of directly to the transmitter. When testing this way, remove the RS-485 end connector and directly connect the wires to the RS-485 pairs:

302 Cable w/RS-485 End	340 BN/MB	340 N2	Series 3000
Red	RS-485 +	N2 +	RS-485B
White	RS-485 –	N2 –	RS-485A
Black	REF	REF	RS-485 Gnd

When the **RS-485 Test** button is selected, the following screens appear:

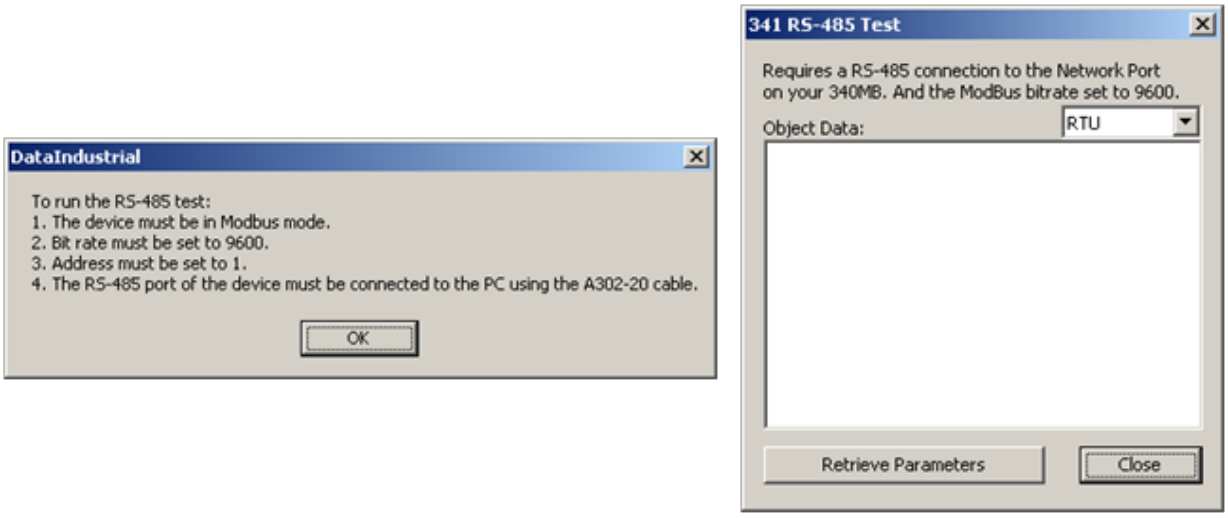
DataIndustrial
To run the RS-485 test:
1. The device must be in Modbus mode.
2. Bit rate must be set to 9600.
3. Address must be set to 1.
4. The RS-485 port of the device must be connected to the PC using the A302-20 cable.
OK
341 RS-485 Test
Requires a RS-485 connection to the Network Port on your 340MB. And the ModBus bitrate set to 9600.
Object Data:
RTU
Retrieve Parameters
Close

Figure 32: Test screens

Factory Default Settings

Table 4 is a list of factory default settings for all 340BN/MB variables. Change the parameter settings to best fit your application. Record the settings in the table for future reference.

Description	Default Value	Customer Value
Flow Sensor Type	Pulse	
"K" Offset	1	
"Offset" Value	0	
Flow Rate	gpm	
Flow Total	gallons	
Temperature	º F	
Energy Calculation	absolute	
Temperature Sensor Type	thermistor	
Energy Rate	kBtu/hr	
Energy Total	Btu	
Flow Filter Coefficient	5	
Energy Filter Coefficient	1	
Energy Filter Coefficient	1	
MS/TP Address	1	
MS/TP Baud Rate	9600	
BACnet Device #	—	
BACnet Max Master	127	

Table 4: Default settings

SPECIFICATIONS

Power	
Power supply	12…24V AC
	12…35V DC
Current draw:	115 mA max. at 12V DC
Flow Sensor Input	
Pulse Type Sensors:	
Signal amplitude	2.5V DC threshold
Signal limits	Vin < 12V (DC or AC peak)
Frequency range	4…1000 Hz
Pull-up:	15V DC @ 2k Ω source Impedance
Sine Wave Sensors:	
Signal amplitude	30 mV p-p threshold
Signal limits	Vin < 12V (DC or AC peak)
Frequency	4…1000 Hz
Power Out Terminal	15V DC ± 1V DC @ 500 Ω source Impedance
Temperature Sensor (2 of same type required) Input	
• 10k Ω thermistor, 2 wire, type II, 10k Ω @ 25°C (77° F)	
• 100 Ω platinum RTD, DIN calibration curve, conforms to IEC-751 Standard	
• 1000 Ω platinum RTD, DIN calibration curve, conforms to IEC-751 Standard	
Calibration range of measurement	0…150° C (32…302° F)
Communication Port	RS-485 with termination, pull-up and pull-down jumpers
Pulse Output	
• Isolated solid-state switch in any standard or custom total units	
• Adjustable 50 ms to 1.0 second pulse output width in 50 ms increments	
Maximum sinking current:	100 mA @ 36V DC
Temperature	
Operating	0…70° C (32…158° F)
Storage	– 40…85° C (– 40…185° F)
Weight	4.8 oz with connector headers installed
Sensor Calibration	
Badger Meter	Use K and offset values provided in sensor manual
Other Sensors	Check with respected manufacturer of flow sensor and with factory
Units of Measure	
Flow Measurement:	
Rate	gpm, gph, l/sec, l/min, l/hr, ft^3/sec, ft^3/min, ft^3/hr, m^3/sec, m^3/min, m^3/hr
Total	Gallons, Gallons X 100, Gallons X 1000, Liters, Cubic Feet, Cubic Meters
Energy Measurement:	
Rate	kBtu/min, kBtu/hr, kW, MW, hp, tons
Total	Btu, kBtu, MBtu, kWh, MWh, kJ, MJ
Temperature Measurement	Fahrenheit, Centigrade
Programming	
• Requires PC or laptop running Windows 2000, XP, Vista or Windows 7	
• Data Industrial 340BN/MB Programming Kit A-301-20 containing software and Data Industrial Series programming cable is required for programming and setup	

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